8-C-53

SERVICE MANUAL

B+K PRECISION Model 280

DIGITAL MULTIMETER

B+K PRECISION

Product of DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

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DESCRIPTION

The Model 280 Digital Multimeter has been designed to accurately measure DC and AC volts, DC and AC current, and Ohms. The operation of the Function switch selects the type of measurement to be performed.

A HI-LO Ohms feature permits making in-circuit resistance measurements at voltage levels below the threshold conduction of semiconductors. The indicator shows H or L, depending on the range selected.

The Model 280 is battery operated using four "C" size batteries, Ni-Cad, alkaline or carbon zinc. Provision is also made for a charger/converter unit (B & K Model BC-28) which is plugged into a jack located on top of the unit.

An overload protection system provides maximum protection of the instrument in the event of extreme overload accidents.

Two test leads, red and black, are provided.

SPECIFICATIONS

DC Voltage

Ranges:	±0-1000mV, 10V, 100V, 1000V.
Accuracy +25°C ±1°C:	±0.5% of reading, ±0.5% full range, ±1 LSD, 1000mV, 10V, 100V ranges. ±1.0% of reading, ±0.5% of full range, ±1 LSD, 1000V range.
Temperature Coefficient, +15°C to +35°C:	±0.025%/°C.
Input Impedance:	10 meg ohms.
Polarity Indications:	Automatic; minus sign shown, plus sign implied.
Circuit Protection, All Voltage Ranges:	±1000VDC or AC RMS.

AC Voltage

(Average reading circuitry calibrated to read RMS value of pure sign wave.)

Ranges:	0-1000mV, 10V, 100V, 1000V
Accuracy +25°C ±1°C:	±1.0% of reading, ±1.0% of full range, ±1 LSD, 1000mV, 10V, 100V ranges. ±2.0% of reading, ±1.0% of full range, ±1 LSD, 1000V range.
Temperature Coefficient, +15°C to 35°C:	±0.025%/°C.
Frequency Response:	50-200 Hz.
Input Impedance:	10 meg ohms.
Circuit Protection, All Voltage Ranges:	±1000VDC or AC RMS.

DC Current

Ranges:	0-1000μA, 10mA, 100mA, 1000mA.
Voltage Drop (Measured at Instrument Terminals):	Nominal 100mV full range, 1000μA, 10μA, 100μA ranges. Nominal 300mV full range, 1000mA range.
Accuracy, +25°C, ±1°C.	±1.0% of reading, ±1.0% of full range, ±1 LSD, 1000μA, 10mA, 100mA ranges. ±2.0% of reading, ±1.0% of full range, ±1 LSD, 1000mA range.
Temperature Coefficient, +15°C to +35°C:	±0.05%/°C.
Polarity Indication:	Automatic; minus sign shown, plus sign implied.
Circuit Protection, All Ranges:	Fuse and Diode. Fuse (7AG-1A) externally accessible.

AC Current

Ranges:	0-1000μA, 10mA, 100mA, 1000mA.
Voltage Drop (Measured at Instrument Terminals):	Nominal 100mV RMS full range, 1000μA, 10mA, 100mA ranges. Nominal 300mV RMS full range, 1000mA range.
Accuracy, +25°C, ±1°C:	±1.0% of reading, ±1.0% of full range, ±1 LSD, 1000μA, 10mA, 100mA ranges. ±2.0% of reading, ±1.0% of full range, ±1 LSD, 1000mA range.
Temperature Coefficient, +15°C to +35°C:	±0.05%/°C.
Frequency Response:	50-200 Hz.
Circuit Protection, All Ranges:	Fuse and diodes. Fuse externally accessible.

Resistance

Ranges:	0-100Ω, 1000Ω, 10KΩ, 100KΩ, 1000KΩ, 10MΩ.
Polarity	Plus (+) jack is positive for all ranges.
Accuracy, 25°C ±1°C:	±1.0% of reading, ±1.0% of full range, ±1 LSD, 100Ω, 100Ω, 1000Ω, 10KΩ, 100KΩ, 1000KΩ ranges. ±1.5% of reading, ±1.0% of full range, ±1 LSD, 10MΩ range.
Temperature Coefficient, +15°C to +35°C:	±0.05%/°C.
Test Currents:	100Ω - 1mA Lo (100mV, full range) 1000Ω - 1mA Hi (1V, full range) 10KΩ - 10μA Lo (100mV, full range) 100KΩ - 10μA Hi (1V, full range) 1000KΩ - 100nA Lo (100mV, full range) 10MΩ - 100nA Hi (1V, full range)
Circuit Protection:	1000KΩ and 10MΩ: Continuous ±1000VDC or AC. 10KΩ and 100KΩ: Continuous ±400VDC or AC. Will withstand momentary overloads to ±1000 VDC or AC. 100Ω and 1000Ω: Continuous ±125VDC or AC. Will withstand momentary overloads to ±1000VDC or AC.

General

Operating Temperature:	0°C to +50°C.
Overrange Indication, All Ranges and Functions	The display will flash when the input exceeds the value of the range selected.

Settling Time, All Ranges and Functions	Less than one second, typically 0.5 second.
Power Requirements:	4 "C" size batteries, Ni-Cad, Alkaline or Carbon Zinc, with provision for charger/converter. NOTE: Batteries or charger/converter are not supplied.
Battery Life:	Better than 50 hours (with Alkaline batteries, continuous use).
Accessories (Included):	2 Test Leads.
Size:	4 3/8" W x 6 3/8" H x 2" D.
Weight:	2 lbs.

DISASSEMBLY INSTRUCTIONS

1. Loosen captive screw on bottom cover and remove bottom cover.
2. Remove batteries.
3. Remove four screws from bottom of main case.
4. Unsolder the plus (+) test lead connection from printed circuit board and remove top cover.
5. Remove black felt switch cover, when used, and the Range and Function switch knobs.
6. Lift the top of the metal/paper shield and remove red plastic display cover.
7. Remove two screws from top of printed circuit boards and remove boards from case.

   NOTE: Care should be taken when removing printed circuit boards from case. It may be necessary to squeeze the battery clips in order to remove printed circuit boards from the case.
8. Unsolder the clip attached to shield from the switch frame and remove shield and insulator from printed circuit boards.

REASSEMBLY

1. Replace insulator and shield around bottom portion of the printed circuit board.
2. Insert printed circuit boards into case and replace two mounting screws (one in each board) and tighten screws.
3. Solder clip attached to shield to the Function switch frame.
4. Place red plastic display cover into proper position.
5. Replace the Range and Function switch knobs, and black felt switch cover, if used.
6. Place top cover into position. Properly position the plus (+) test lead terminal onto printed circuit board.
7. Replace four screws holding top cover to case and tighten.
8. Solder plus (+) lead to printed circuit board.
9. Replace the four "C" batteries into case, observing proper polarity.
10. Place bottom cover into position and tighten captive screw.

CALIBRATION PROCEDURES

The instrument should not require calibration unless repairs have been made that change the factory calibration. Check for proper operation of all functions before attempting to calibrate the instrument.

The following procedure requires a low-impedance, constant voltage source of 0.1% accuracy or better. Use of sources less accurate will reduce the accuracy of the instrument.

Preliminary Instructions

Models Below Serial No. 39-03500 (Refer to Fig. 1 for Location of Adjustments.

1. Loosen captive screw on bottom cover and remove cover and batteries.
2. Remove the four screws holding top cover.
3. Unsolder the plus (+) jack from edge of printed circuit board and solder a short wire to this point to serve as a temporary (+) input terminal.
4. Remove the top cover, exposing the printed circuit boards.
5. Replace batteries and back cover and proceed with Step 1 under "Procedure."

Models Above Serial No. 39-03500 (Refer to Fig. 1 for Location of Adjustments.

1. Loosen captive screw on bottom cover and remove cover. It may be necessary to place a piece of tape over batteries to hold them in place.
2. Proceed with Step 1 under "Procedure."

Procedure

NOTE: It is important that this procedure be followed in the order given below.

1. Set Function switch to DCV, and Range switch to 1000mV scale.

2. Short input terminals together.

3. Turn R25, Zero Adjust control, so that minus (-) sign is just flickering. Then turn until the minus sign is off.

   NOTE: If zero is not obtained within the adjustment range of R25, the unit is defective and cannot be calibrated.

4. Apply +2mVDC to the input terminals and adjust R22, A/D Zero, for a zero reading.

5. Apply +10mVDC and -10mVDC to the input terminals and check reading for symmetry. If readings are not symmetrical, adjust R25, Zero Adjust control, until symmetry is obtained.

6. Apply +1 volt DC and -1 volt DC to input terminals and adjust R23, Range Adjust, so that the range error is split between polarities.

7. Set Function switch to OHMS, and Range switch to 100Ω scale.

8. Connect a 90-ohm, ±0.1%, resistor across the input terminals.

9. Adjust R24, Lo Ohms Cal., for a 90.0 reading.

10. Set Range switch to 1KΩ scale.

11. Connect a 900-ohm, ±0.1% resistor across input terminals.

12. Adjust R21, Hi Ohms Cal., for a 900 reading.

13. Check all DCV, ACV, DCA, ACA, and OHMS scales for correct readings.

14. Reassemble unit.

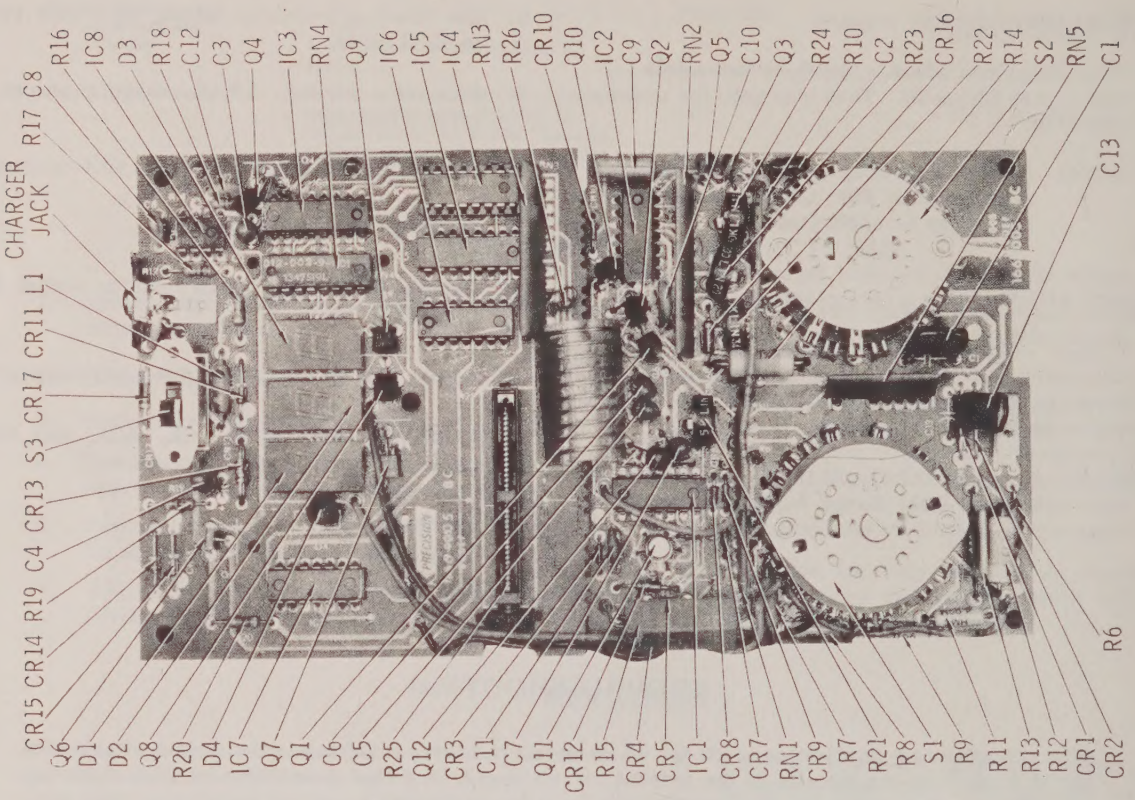
TROUBLESHOOTING

All troubleshooting procedures, such as voltage measurements, waveform analysis, and adjustments, can be made from the top side of the printed circuit board. See Figs. 2 and 3 for location of voltage and waveform test points, and the schematic in Fig. 4 for correct voltages and waveforms. Disassembly of the printed circuit board will only be necessary if a component needs replacing.

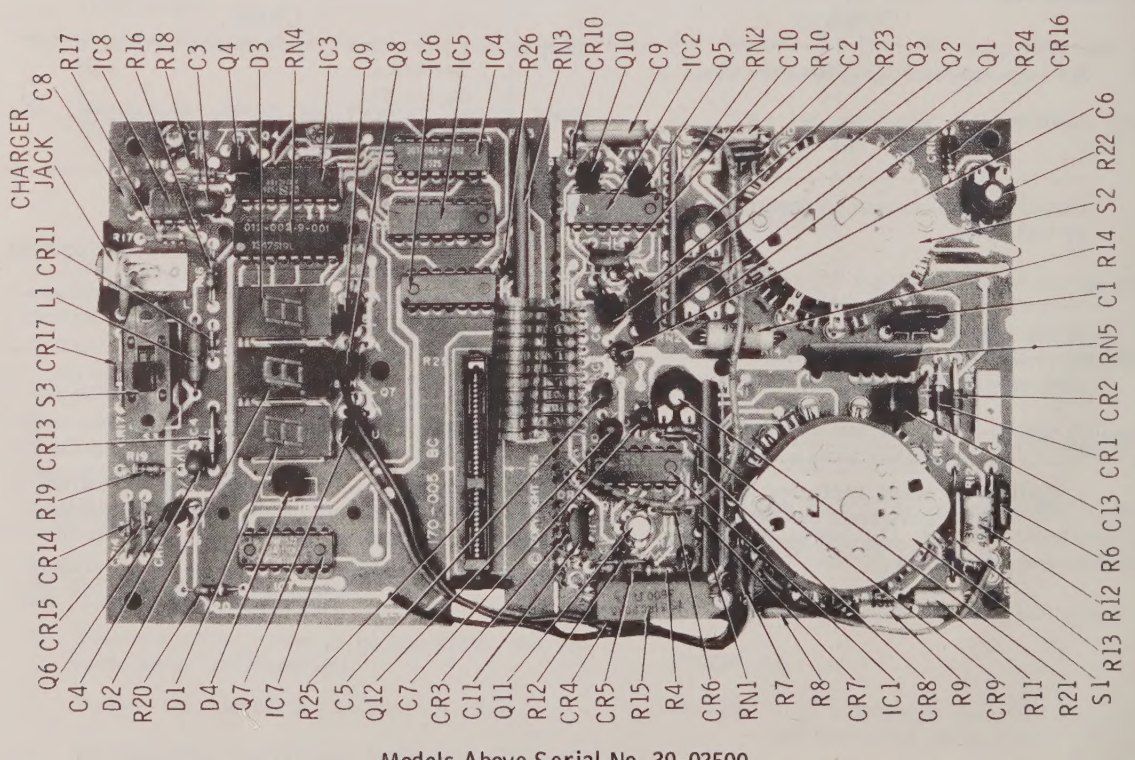
TROUBLESHOOTING CHART

Symptom	Check
Set inoperative; display does not come on.	1. Batteries. 2. Switch S3. 3. Integrated circuits - IC4, IC8, IC3 (See CAUTION Note).
Display light comes on, but no value is indicated by test leads.	1. Fuse F1. 2. Broken test lead wire. 3. Test lead connection not soldered to printed board.
Minus light remains flashing.	1. Bad Zero control R25.
Any one of display elements does not light.	1. Replace display element D1, D2, or D3. 2. Transistor Q7, Q8, Q9. 3. Range Switch S1 (Decimal Points).

CAUTION: When replacing IC4, IC3, IC5, IC6, or IC7, a static charge from personnel and/or materials can permanently damage these devices. Do not handle pins of the device except with ground straps. Do not replace these devices with voltage applied to the circuit.



Models Below Serial No. 39-03500



Models Above Serial No. 39-03500

Fig. 1. Top View of Printed Circuit Board — Parts Identification.

PARTS LIST

NOTE:

Standard value resistors and capacitors are not listed. Minimum charge $5.00 per invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charges. Specify serial number when ordering replacement parts.

Ref. No	Part No.	Description
TRANSISTORS		
Q1 thru Q3,	176-050-9-001	MPS-6515 Silicon Transistor
Q4,Q7 thru Q9	176-051-9-001	2N5818 PNP Silicon Transistor
Q5, Q6, Q10	177-015-9-001	MPS-6519 NPN Silicon Transistor
Q11	182-033-9-001	FET, Dual "N" Channel J-FET
Q12	182-036-9-001	FET (Input Clamp Diode)
INTEGRATED CIRCUITS		
IC1, IC2	307-060-9-001	324 Quad Op-Amp
IC3	307-001-9-001	9511 \ Note Location of
IC3	307-068-9-001	74C48 / Jumper, Pin 5.
IC4	307-066-9-001	C-MOS, LSI Counter Latch
IC5	307-064-9-001	4040
IC6	307-062-9-001	4013
IC7	307-063-9-001	4011
IC9	307-065-9-001	NE555V
DIODES AND RECTIFIERS		
CR1, CR2, CR17 CR3 thru	151-018-9-001	Rectifier, 600V, P1V, 1 Amp Silicon
CR11	151-038-9-001	1N4148 Silicon Diode
CR12	152-061-9-001	Zener, 6.8V, 10%, 1 Watt 1N4763
CR13	152-039-9-001	Zener, 12V, 5%, 1 Watt 1N4742A
CR14	152-068-9-001	Zener, 7.5V, -3%+10%, 500m Watt
CR15	152-062-9-001	Zener, 4.3V, 5%, 500m Watt 1N749A
CR16	152-066-9-001	Zener, 6.4V, Reference Diode 1N4565
CAPACITORS		
C1	025-066-9-001	.01 mfd, 600V, 20% Polyester
C2, C13	025-096-9-001	.047 mfd, 100V, 10% Polyester
C3 thru C6	027-010-9-001	10 mfd, 16V, 20% Tantalum
C7	027-009-9-001	15 mfd, 10V, 20% Tantalum
C8	020-137-9-001	270 pf, 500V, 10%, Ceramic Disc
C9	025-095-9-001	.033 mfd, 100V, 10% Polyester
C12 ‡	020-139-9-001	.01 mfd, 25V, -20 +80 Ceramic Disc
CONTROLS AND RESISTORS		
R6	004-125-9-001	0.098Ω, 1/2 Watt, Wirewound
R7	004-147-9-001	0.9Ω, 1%, 1/2 Watt, Wirewound
R8	011-072-9-001	9Ω, 1%, 1/2 Watt, Metal Film
R9	011-073-9-001	90Ω, 1%, 1/2 Watt, Metal Film
R10	011-102-8-474	470K, 5%, 1/2 Watt, Metal Film
R11	011-079-9-001	4.99 meg, 1%, 1/4 Watt, Metal Film
R12, R14	011-085-9-001	49.9K, 1%, 3 Watt, Metal Film
R13	004-149-9-001	449Ω, 1%, Metal Film Special Plate
R15	004-151-9-001†	3.6K, 5%, 3 Watt, Special Metal Glaze
R21	008-219-9-001*	5K, Trimpot
	008-231-9-001**	

Ref. No.	Part No.	Description
CONTROLS AND RESISTORS(Cont'd.)		
R22	008-221-9-001*	100K, Trimpot
	008-228-9-001**	
R23	008-222-9-001*	250Ω, Trimpot
	008-229-9-001**	
R24	008-220-9-001*	30K, Trimpot
	008-230-9-001**	
R25	008-218-9-001	100Ω, 30%, 25 Turn Trimpot
R26	***	4.7K, 5% 1/4 Watt, Carbon
COMBINATION NETWORKS		
RN1	012-005-9-001	Resistor Network
RN2	012-003-9-001	Resistor Network
RN3	012-004-9-001C	Resistor/Capacitor Network
RN4	012-002-9-001	Resistor Network
RN5	012-006-9-001	Resistor Network
INDUCTOR		
L1	041-067-9-001	560μhy Inductor
SWITCHES		
S1	083-177-9-001	Range
S2	083-178-9-001	Function
S3	084-040-9-001	Power, SPDT
MISCELLANEOUS		
D1, D2, D3	238-006-9-001	Display, 7-Element LED
D4	158-004-9-001	Display, (minus sign) single LED
F1	191-320-9-001	Fuse, 7AG, 1A
	260-057-9-001	Overlay, Front Panel
	260-058-9-001	Logo, Front Panel
	271-030-9-001	Case, Main (Plastic)
	271-031-9-001	Case, Bottom (Plastic)
	271-032-9-001	Case, Top (Plastic)
	380-120-9-001	Foot, 7/16" Disc
	380-230-9-001	Filter, Display (Plastic)
	427-014-9-001	10 Lead Jumper
	522-062-9-001	Black Test Lead (Banana to Insulated Clip)
	522-063-9-001	Red Test Lead (Banana to Probe)
	523-115-9-001	Negative Jack/Fuse Holder Assembly
	751-119-9-001	2 Knobs (Function & Range)
	763-041-9-001	Fuse, P.C.B. Mount
	769-081-9-001	Spring, Battery (Jumper Contact)
	769-080-9-001	Battery Contact (Single)
	769-077-9-001	Mask, Minus Sign
	773-059-9-001	Phone Jack, Subminiature
	653-018-9-001	Nut for Phone Jack (Miniature)
	342-030-9-001	Insulator, Vinyl (For Phone Jack)

‡ Remove from unit. Causes TV interference.

* Units with Vertical Trimpots (below Serial No. 39-03500).

** Units with Horizontal Trimpots (above Serial No. 39-03500).

*** Part of 012-004-9-001C. If original network (RN3) is replaced, disregard resistor R26 and use proper RN3 as shown.

† See Instruction Manual for Warning on substitution of Fusible Resistor R15.

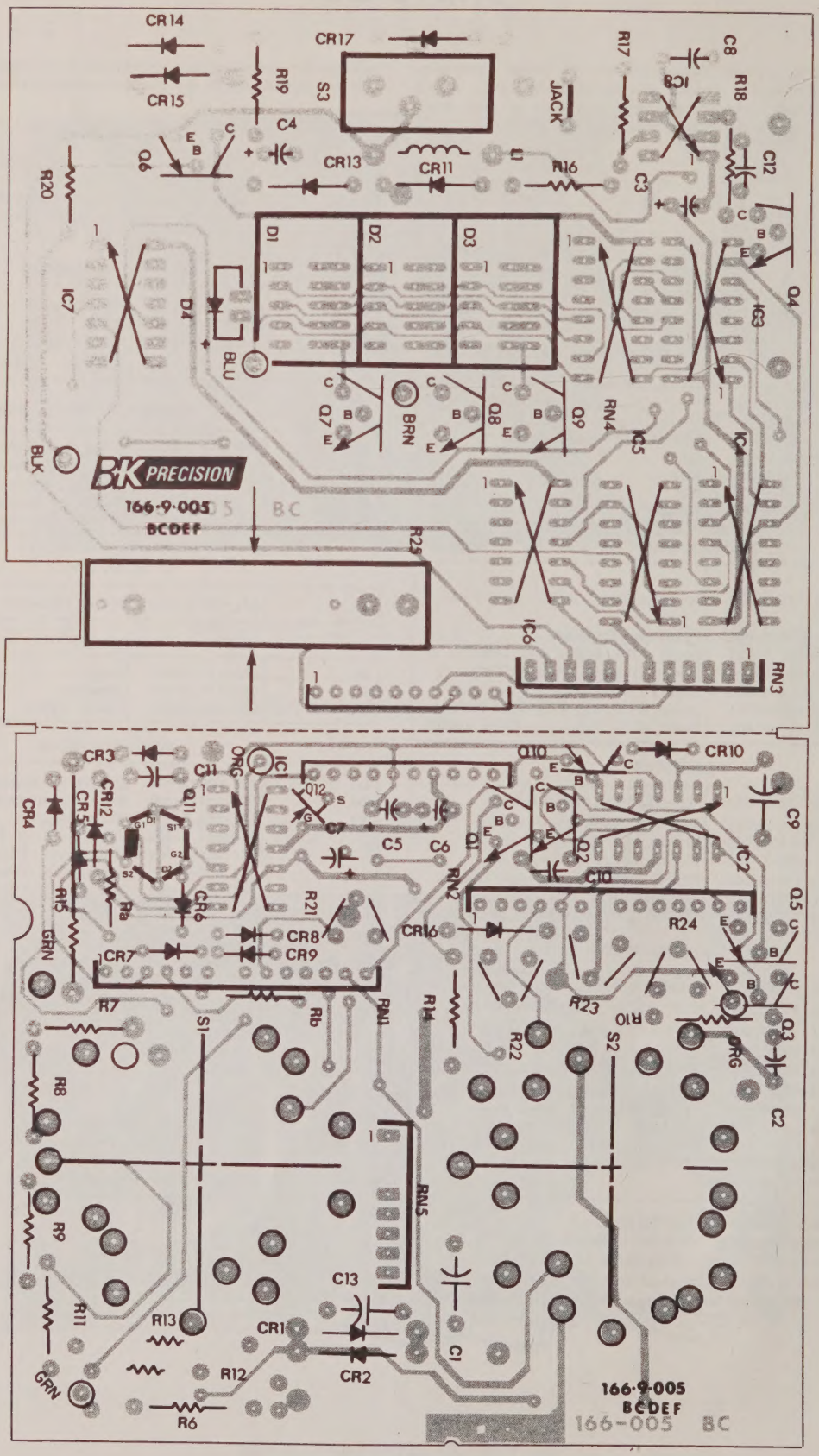


Fig. 2. Printed Circuit Board Layout, Component Side — Models Below Serial No. 39-03500.

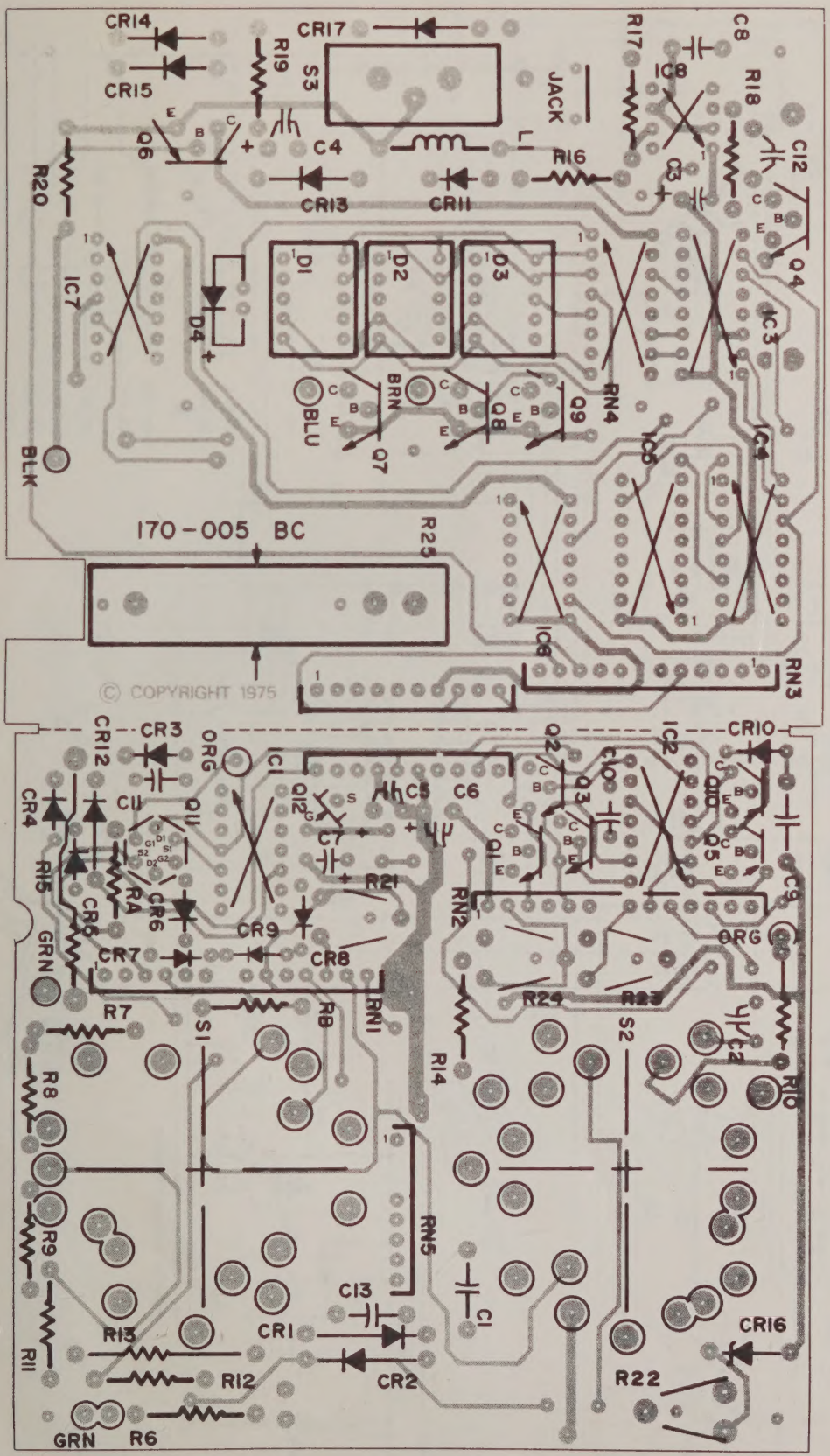
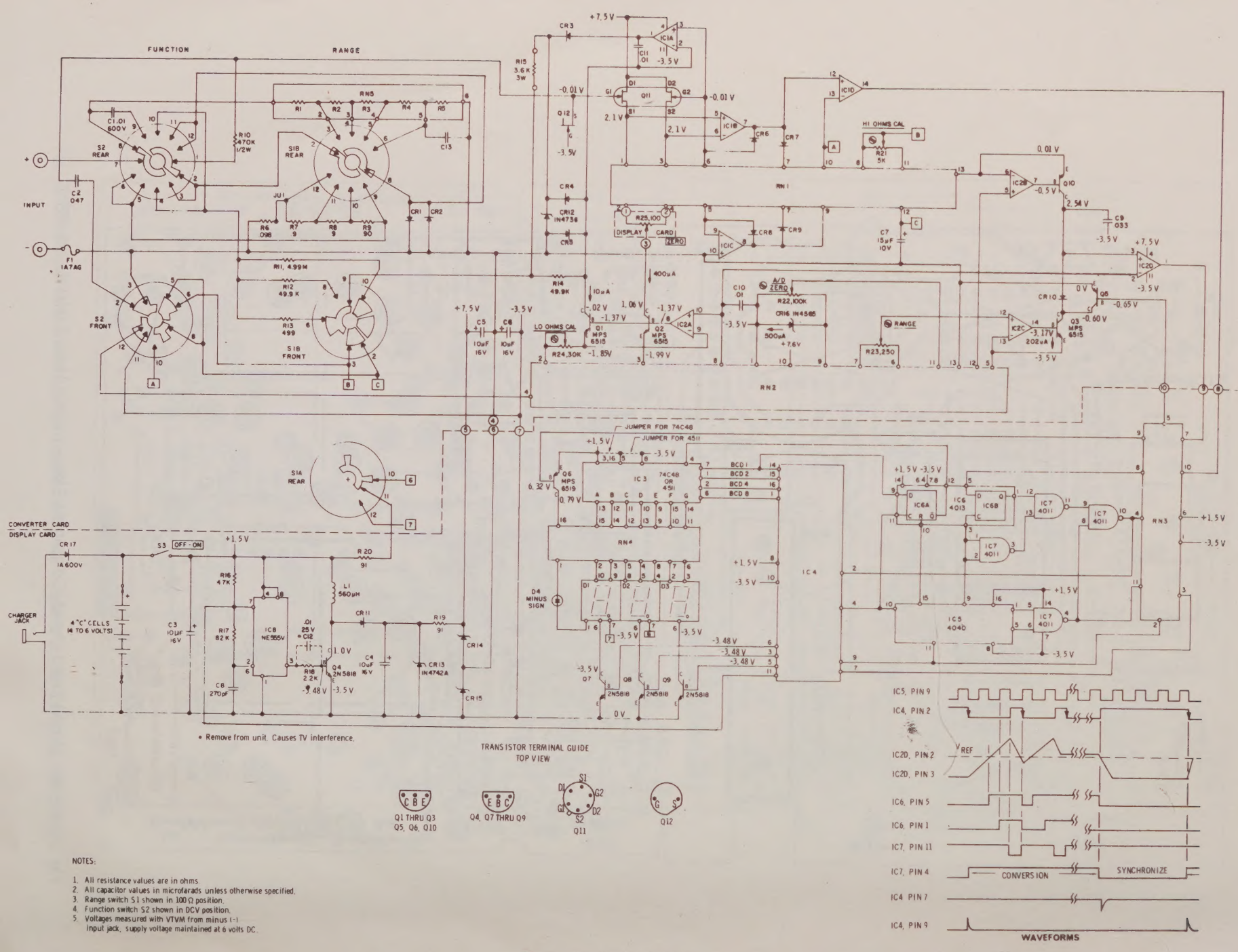


Fig. 3. Printed Circuit Board Layout, Component Side — Models Above Serial No. 39-03500.



NOTES:

1. All resistance values are in ohms.
2. All capacitor values in microfarads unless otherwise specified.
3. Range switch S1 shown in 100 Ω position.
4. Function switch S2 shown in DCV position.
5. Voltages measured with VTVM from minus (-) input jack, supply voltage maintained at 6 volts DC.

Fig. 4. Model 280 Schematic.